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07-06-07

2833
#5
4-12-03IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Erich Russ et al.
Serial No.: 09/973,121
Filing Date: 10/09/2001
Title: DEVICE FOR THE ROTATABLE COUPLING
OF TWO COAXIAL CONNECTION ELEMENTS
Group Art Unit: 2833
Examiner: Unknown
Attorney's Docket No.: GOTZ-10

Assistant Commissioner For Patents
Washington, D.C. 20231

Sir:

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PETITION TO MAKE SPECIAL BECAUSE OF ACTUAL INFRINGEMENT(37 C.F.R. § 1.102 and M.P.E.P. § 708.02)

Applicants hereby petition to make this application special because of actual infringement.

Accompanying this petition is a STATEMENT by the Inventors in Support of Petition to Make Special Because of Actual Infringement.

A check in the amount of One Hundred Thirty Dollars (\$130.00) payable to the Commissioner of Patents and Trademarks also is enclosed herewith to cover the fee required in connection with this Petition.

03/10/2003 ZJUHARI 00000058 09973121

01 FD:1460

130.00 DP

GOTZ-10

Please charge any additional fees due in connection with
this submission, or credit any overpayment, to Deposit Account
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James A. Sheridan

(PERSON MAILING)

James A. Sheridan 03/05/03
(SIGNATURE)

Respectfully submitted,

James A. Sheridan 3/5/03

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STATEMENT

As below-named applicants of the United States Patent Application 09/973,121, entitled „DEVICE FOR THE ROTATABLE COUPLING OF TWO COAXIAL CONNECTION ELEMENTS“ and filed on 10/09/2001, we hereby declare that:

A) An infringing device of the PSL of America Inc. is actually on the market in USA, in particular:

In the year 2002, there has been published a prospectus called „Worm Drive Systems - Production Programme“, publishing no. 14/2002-IP-A, by the international company combine PSL, consisting of the companies

- PSL, a.s.
Robotnícka
Slovak Republic
- PSL of America Inc.
21467 Enterprise Parkway
Twinsburg, Ohio 44087
USA
- PSL Wälzlager GmbH
Germany

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The companies in USA and Germany sell the products, which are manufactured in the Slovak Republic, to USA and West Europe, respectively. So the articles of this prospectus are offered in the United States.

This prospectus shows on its first page a picture of a covered worm drive (the upper picture).

A section through such covered worm drive can be seen on top of page 13 of this prospectus. This worm drive is called „heavy duty worm drive with double row slewing ring IP107-422L/R Design H“. This corresponds with Table 1 on page 4 of this prospectus, where one can see that covered types of PSL worm drives have the design symbols C, D, G, H, L, M, P or R. (Therefore, even the other worm drives of page 13 are covered types, as they have the design symbol R.)

The picture on top of page 13 is supplemented by the information on page 5 of this prospectus, right picture on the bottom, as this shows the basic type of covered worm drives of PSL (see the title of this page and of the relevant picture).

B) A rigid comparison of the alleged infringing device with the claims of the above mentioned application has been made, and in our opinion, claims 1 to 5, 7 and 10 of the present patent application are unquestionable infringed, in particular:

Claim 1:

From the pictures on top of page 13 (IP107-422L/R), one can see:

A device comprising two coaxial rings as connection elements, a double row rolling bearing between these rings, a worm with coupling elements for a mountable drive, meshing with a toothing at the outer side of the outer ring, and securement means arranged in the form of a crown in a front end of the toothed ring, whereby the securement means are arranged between the toothing and the rotating bearing (first part of claim 1).

Further, the toothing of the outer ring is enclosed by a housing (see the right side of the vertical section on top of page 13), that is fixed to the inner (untoothed) ring (see the fitting bores of the housing and of the inner ring in line with each other for receiving a mounting screw as shown on bottom of page 5). This housing surrounds the toothed connection element at its front end. The securement means (bores) of

the untoothed (inner) ring are arranged in this ring itself. As these are through-bores, the inner ring may be mounted directly with both of its front ends to a machine part.

Therefore, the heavy duty worm drive IP107-422L/R of PSL shows all features of claim 1 of the present patent application.

Claim 2:

As the worm drive IP107-422L/R is of the design type H, it is made from steel (see table 1), and it has to be manufactured by machining. As the outer ring comprises the toothing as well as a guideway for the ball-bearing race, these elements have to be formed by machining of the same element.

Claim 2 of the present patent application is entirely fulfilled by the heavy duty worm drive IP107-422L/R of PSL.

Claim 3:

According to the picture on top of page 13, both connection elements are formed as concentric rings, and the securement means are formed as bores in the form of a crown.

Claim 3 of the present patent application is entirely fulfilled by the heavy duty worm drive IP107-422L/R of PSL.

Claim 4:

According to the picture on top of page 13, the toothed connection element (outer ring) is formed as an externally toothed ring.

Claim 4 of the present patent application is entirely fulfilled by the heavy duty worm drive IP107-422L/R of PSL.

Claim 5:

According to the picture on top of page 13, the ball-bearing race/guideway and the tothing are arranged on opposite surfaces of the outer ring.

Claim 5 of the present patent application is entirely fulfilled by the heavy duty worm drive IP107-422L/R of PSL.

Claim 7:

From the picture of page 1 of the PSL prospectus, one can see that the bores of the outer ring are provided with an internal thread. Even the bores of the outer ring of the worm drive IP107-422L/R of PSL must have internal threads, as the other ends of these bores are covered by the housing.

Claim 7 of the present patent application is entirely fulfilled by the heavy duty worm drive IP107-422L/R of PSL.

Claim 10:

From the pictures of pages 1, 6 and 13 of the PSL prospectus, one can see that the housing part has the form of an annulus and surrounds the toothed element. This annulus extends along a front end of the toothed ring and parallel to the latter.

Claim 10 of the present patent application is entirely fulfilled by the heavy duty worm drive IP107-422L/R of PSL.

C) As mechanical engineers and chiefs of an engineering works factory, we have a good knowledge of the pertinent prior art. Furthermore, with regard to a parallel patent application 01 105 573 at the European Office, a careful and thorough search of the prior art was conducted by the European Patent Office, in particular:

The search report of the European Patent Office is enclosed. Only 3 documents have been found:

1. WO 99 24730
2. EP 0 631 068 A
3. US 3 575 060 A

At the third document, securement means in the form of a crown (bores) are entirely missing.

At the second document, the securement means are placed on top of the inner ring. But the housing surrounds only the toothing of the inner ring, not its bottom side.

Further, at both documents, always the inner ring carries the toothing. This is also true for all embodiments of the first document except the embodiment of fig. 4. But at this embodiment, the securement means of the outer ring are not arranged between the toothing and the bearing.

Therefore, claim 1 is new with regard to devices with a toothing on the outer ring.

Further, at all embodiments of the first document, the guideway of the ball-bearing race and the toothing are not formed by machining of the same connection element according to claim 2 of the present patent application. Therefore, claim 2 provides additional, patentable matter with regard to the first document.

With regard to claim 7, at the first document, the securement bores of the outer ring have no internal thread. This is true for the second document, too. At the third document, there are no securement bores. So claim 7 provides additional, patentable matter.

Further features for delimiting the claims over the prior art are included within the description, for example at page 5, lines 14 to 19: The rolling bearing is arranged at

the same height as the toothing. This feature is realized at the worm drive IP107-422L/R of PSL, too.

Applicant's signature:

Applicant's full name:

Date:

Residence:

Post office address:

Citizenship:


Erich Buss

17.03.03

Poppenwind 21

DE-91350 Gremsdorf, Germany

same

Germany

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Applicant's full name:

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Citizenship:


Dipl.-Ing. Werner Schröppel

Feb 14th, 2003

Schulstraße 28a

DE-90530 Wendelstein, Germany

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Enclosures:

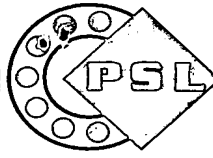
Prospectus „Worm drive systems - Production Programme“ of PSL

Search report of the European Patent Office

WO 99 24730

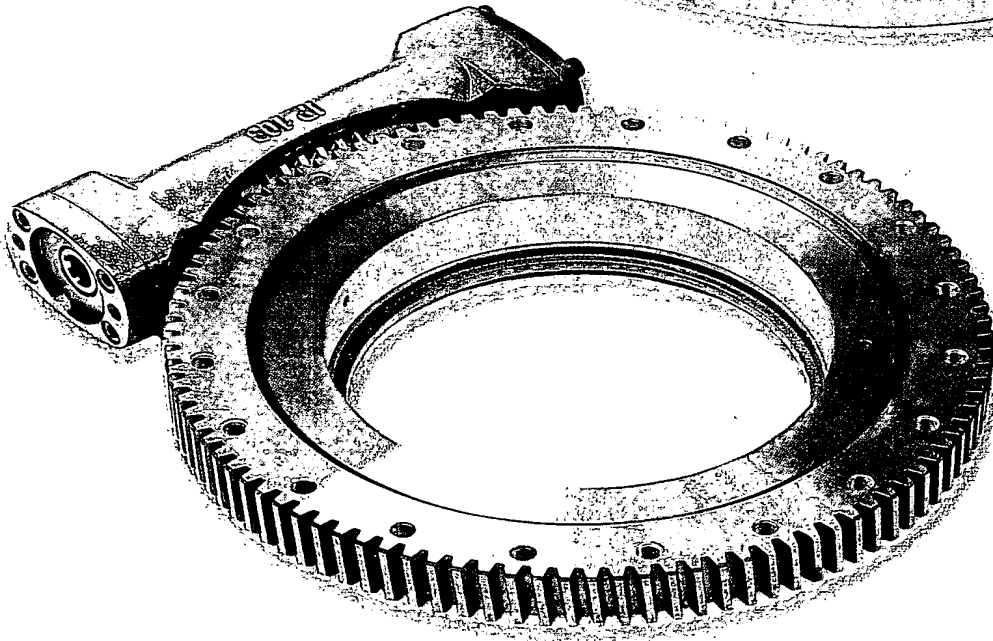
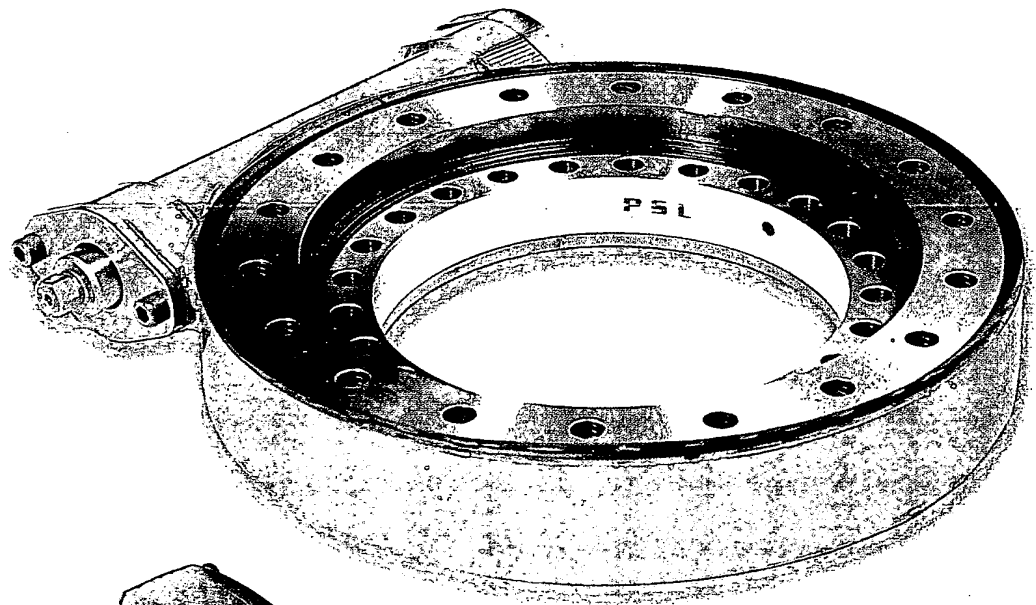
EP 0 631 068 A

US 3 575 060 A



Worm Drive Systems


Production Programme





BASIC INFORMATION

- * PSL, a. s., is a bearing and slewing ring manufacturer with many years of tradition and experience.
- * PSL, a. s., has a developed, utilized and certified system of the quality assurance programme according to the standard DIN EN ISO 9001, VDA 6.1 and QS 9000. This process involves all stages from consulting through development to production services.
- * This publication contains basic information on PSL worm drives and their mounting and maintenance.
- * The PSL worm drive system is a compact unit (slewing ring + base plate + worm) suitable for slow rotation with a continuous/cyclical movement capable of handling combined loads.
- * Solutions to complex applications involving PSL worm drives can be provided by the experts of the PSL Technical Department.
- * The contents of this publication have been carefully reviewed, however due to continuous technical development, PSL reserves the right to make technical changes and/or amendments without prior notice.


CERTIFICATE
DNV ZERTIFIZIERUNG UND UMWELTÜTACHTER GMBH

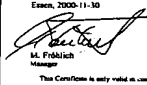

certifies that the company

PSL
Rabotnická ul.
SK - 01734 Pavazská-Bystrica
Slovakia


has established a
quality system
in conformity with
EN ISO 9001 : 1994
This certificate is valid for:

Development, design, manufacturing and sales of through-hardened
antifriction roller and ball bearings and large diameter bearings made of
steel and ferrous materials.

This Certificate is valid until:
2003-11-30
Certificate-Registration-No.:
CERT-09900-2000-AQ-ESN-TGA

Exem. 2000-11-30  Exem. 2000-11-30 

This Certificate is only valid in connection with the original Certificate CERT-09900-2000-AQ-ESN-TGA.
Revised Form 1 : 07/93-03/00-00-00-00-00-00


CERTIFICATE
DNV ZERTIFIZIERUNG UND UMWELTÜTACHTER GMBH

certifies that the company

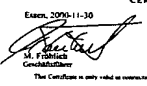

PSL
Rabotnická ul.
SK - 01734 Pavazská-Bystrica
Slovakia

has established a
quality management system
in conformity with the standard
EN ISO 9001 : 1994
and the requirements of
QS-9000 : 1998

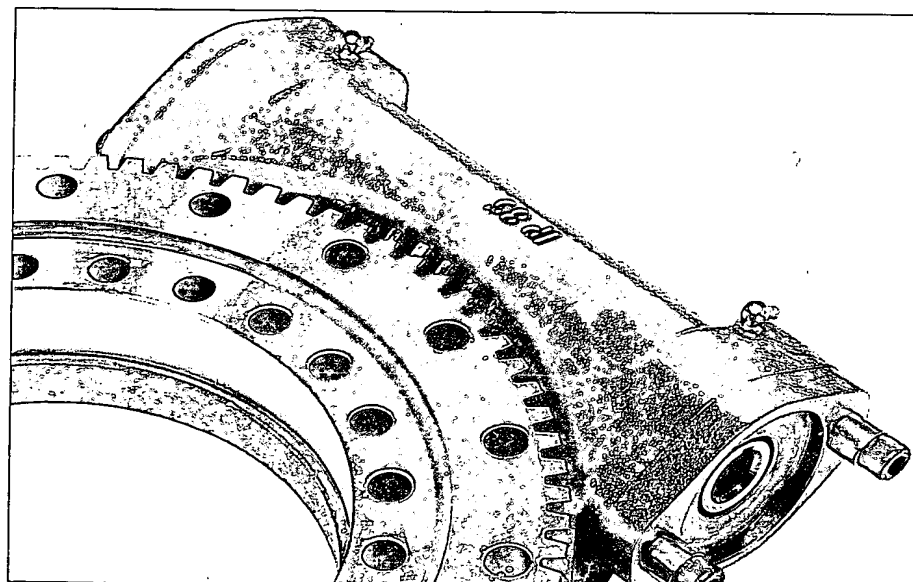
The company has been audited in accordance with the requirements of QS-9000 Appendix B,
Code of Practice for Quality System Registers.

This Certificate is valid for:
Development, design, manufacturing and sales of through-hardened
antifriction roller and ball bearings

This Certificate is valid until:
2003-11-30
Certificate-Registration-No.:
CERT-09900-2000-AQ-ESN-TGA

Exem. 2000-11-30  Exem. 2000-11-30 

This Certificate is only valid in connection with the original Certificate CERT-09900-2000-AQ-ESN-TGA.
DNV ZERTIFIZIERUNG UND UMWELTÜTACHTER GMBH, Schwanenweg 1, 41229 Essen, NRW, Germany
Revised Form 1 : 07/93-03/00-00-00-00-00-00



VDA

CERTIFICATE-EXTENSION
CERT-09900-1-2000-AQ-ESN-VDA
DNV ZERTIFIZIERUNG UND UMWELTÜTACHTER GMBH
VERBAND DER AUTOMOBIL-INDUSTRIE e.V. (VDA) / E-M. VDA - 1697

herewith certifies that the

PSL
at:
Rabotnická ul.
SK 01734 Pavazská Bystrica
Slovakia

Development, design, manufacturing and sales of through-hardened
antifriction roller and ball bearings for the automotive industry
applies a
Quality Management System according to VDA 6, Part 1
(with product development)

This Certificate extension is only valid in connection with ISO 9001 : 1994, QS-9000 : 1998
Certificate-Registration-No. CERT-09900-2000-AQ-ESN-TGA confirming that the QM-system is
supplementary qualified referring to the extended requirements of VDA 6 Part 1 compared to ISO
9001.
The evidence was brought during the Certification Audit, Report-No.: 2363110

This Certificate is valid until: 30. November 2003
Date of issue: 30. November 2000

DNV Zertifizierung und Umweltgutachter GmbH, Schwanenweg 1, 41229 Essen



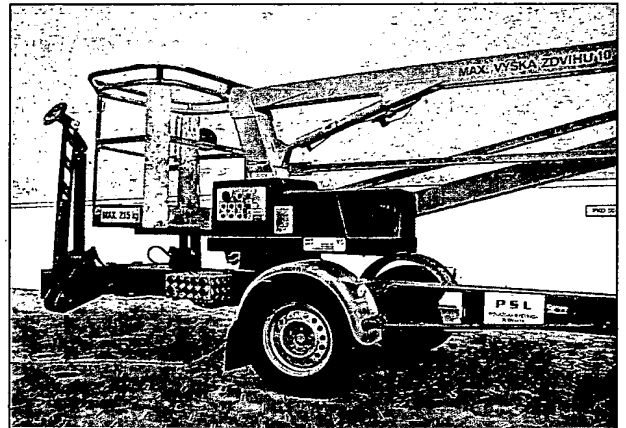
PSL WORM DRIVES

The universal design of PSL worm drive allows:

- continuous or cyclical rotation of the connected superstructure
- various connections with the driving motor
(right or left side per customer's request)
- simple installation
- rational space utilization
- reliable operation with low maintenance requirements

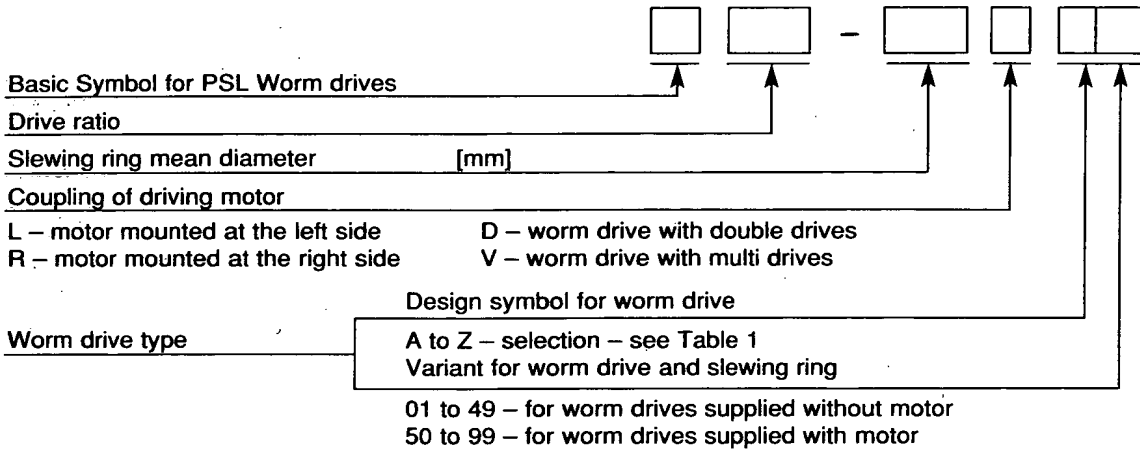
The gear is self-locking, therefore a break is not necessary.

PSL open/covered worm drive systems are produced with multiple combinations suitable for most common applications, such as aerial platforms, positioners and cranes etc.





PART NUMBER DESIGNATION OF PSL WORM DRIVE SYSTEMS



Example of designation:

IP107-422LD01

- IP – PSL worm drive
- 107 – drive ratio 107
- 422 – slewing ring mean diameter 422
- L – motor at the left side
- D01 – worm drive and slewing ring type D01
(helical gear – covered – welded – worm drive supplied without motor)

Table 1

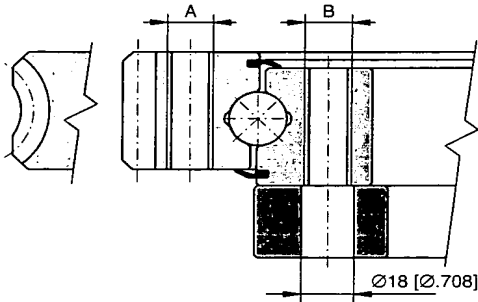
Design Symbol	Type of slewing ring gear					Type of worm drive				
	Helical	Globoidal		Straight	Other	Open	Covered	Casting	Welded	Other
		Steel	Bronze							
A										
B										
C										
D										
E										
F										
G										
H										
J										
K										
L										
M										
N										
O										
P										
R										
S										
T										
U										
V										
W										
X										
Y										
Z										

BASIC TYPES OF WORM DRIVES AND SLEWING RINGS

TYPE 01: A;B=M16
TYPE 05: A;B=5/8"-11UNC-2B

Design E to M

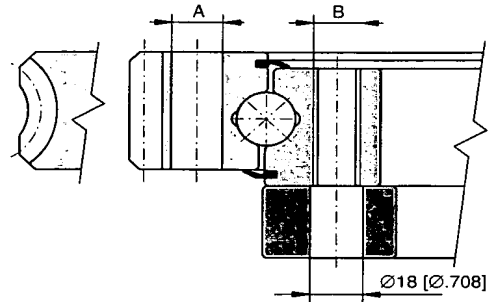
Design A to D



TYPE 02: A=Ø17,5 [Ø.69]; B=M16
TYPE 06: A=Ø17,5 [Ø.69]
B=5/8"-11UNC-2B

Design E to M

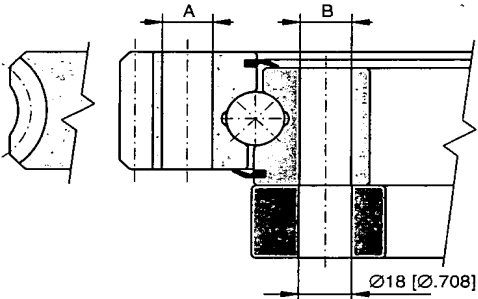
Design A to D



TYPE 03: A;B=Ø17,5 [Ø.69]
TYPE 07: A;B=Ø17,5 [Ø.69]

Design E to M

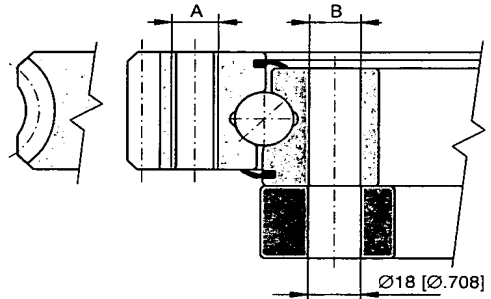
Design A to D



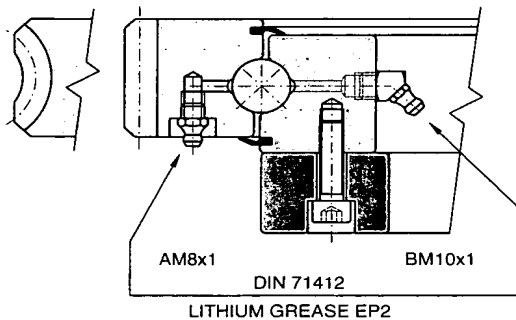
TYPE 04: A=M16; B=Ø17,5 [Ø.69]
TYPE 08: A=5/8"-11UNC-2B
B=Ø17,5 [Ø.69]

Design E to M

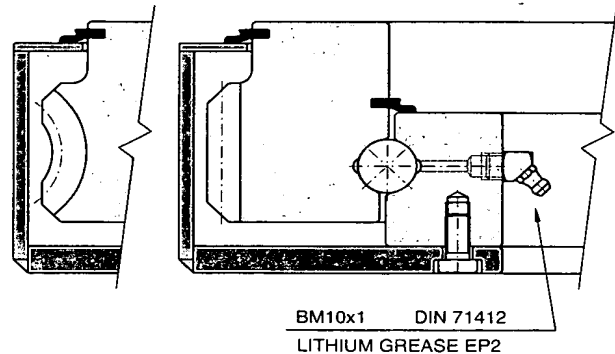
Design A to D



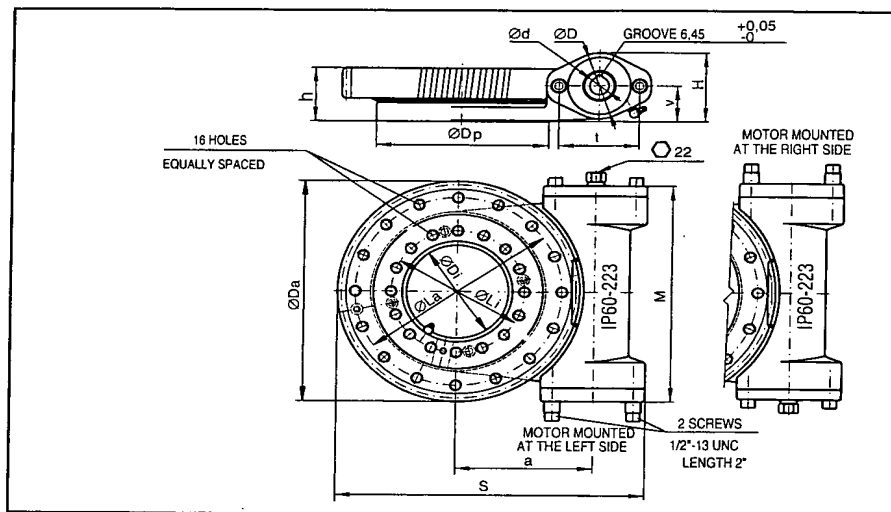
OPEN WORM DRIVES
TYPES 01 TO 08



COVERED WORM DRIVES

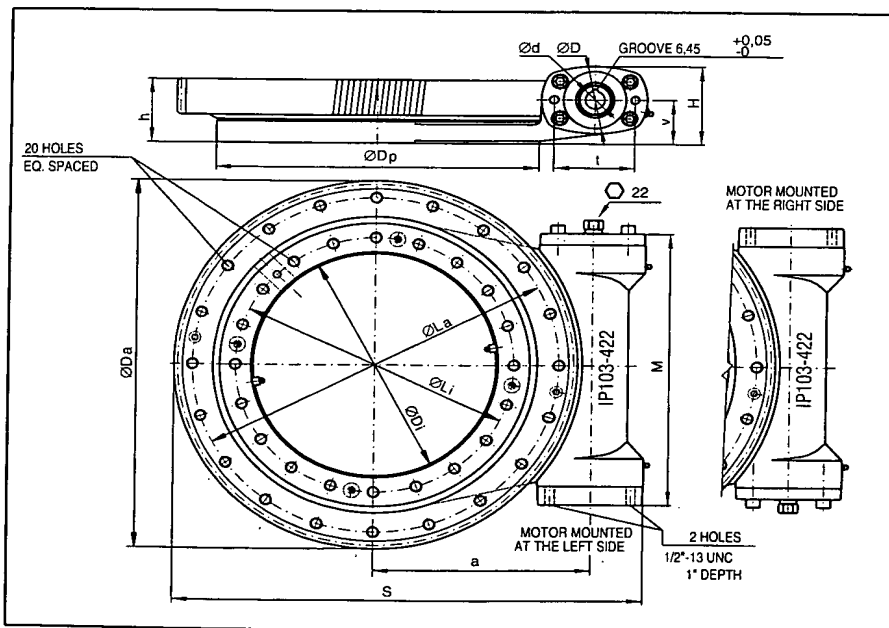
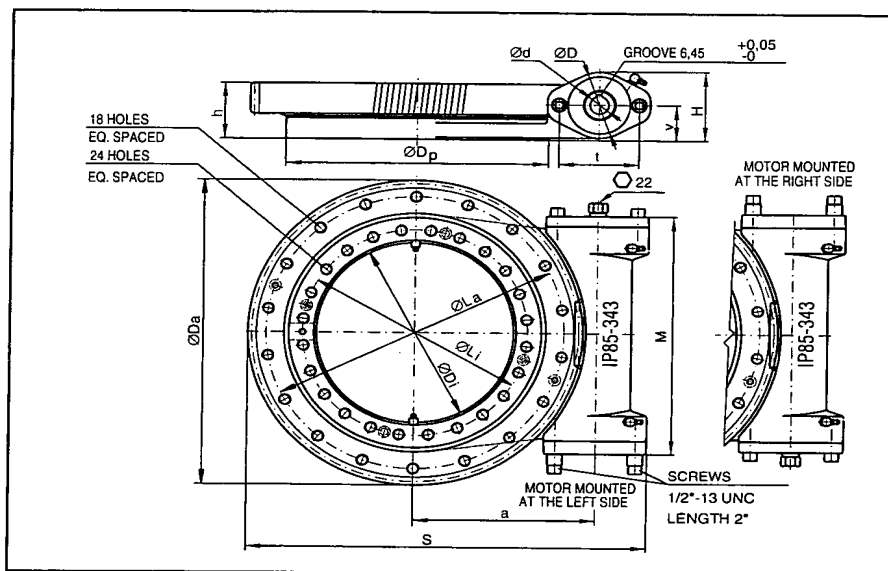


OPEN WORM DRIVES



Small worm drive
IP60-223L/R
Design A

Medium worm drive
IP85-343L/R
Design A



Heavy duty worm drive
IP103-422L/R
Design A

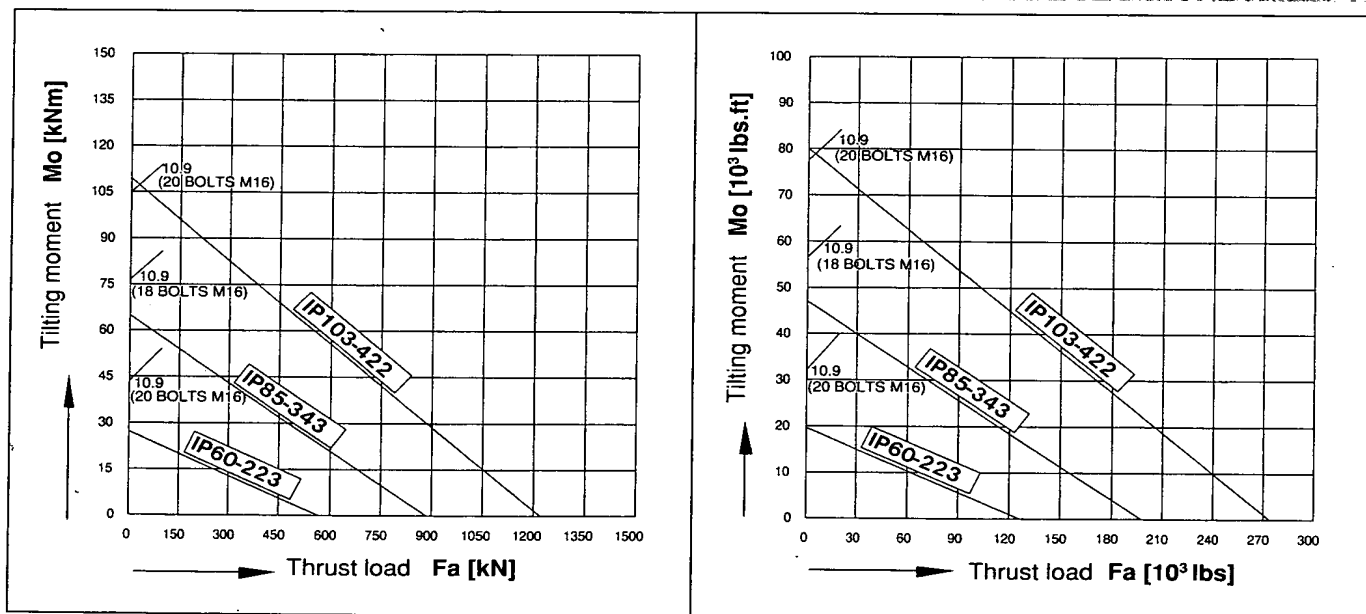
Boundary dimensions for worm drives, design A

Table 2

Designation	IP 60-223		IP 85-343		IP 103-422	
	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
ϕd	25,5	1.004"	25,5	1.004"	25,5	1.004"
ϕD	82,6	3.25"	82,6	3.25"	82,6	3.25"
ϕLi	175	6.89"	295	11.614"	365	14.37"
ϕLa	270	10.63"	390	15.354"	479,4	18.874"
ϕDi	134	5.276"	258	10.157"	300	11.811"
ϕDa	316,6	12.465"	437,3	17.217"	527,8	20.78"
ϕDp	225	8.86"	343	13.5"	425	16.7"
h	77	3.031"	80	3.15"	91	3.58"
H	98,5	3.88"	98,5	3.88"	111	4.37"
v	52,4	2.063"	50,8	2"	63,5	2.5"
t	106,4	4.189"	106,4	4.189"	106,4	4.189"
a	177,539	6.9897"	237,6	9.3543"	282,8	11.13"
S	405	15.95"	527	20.75"	617,5	24.3"
M	312	12.3"	343	13.5"	389	15.31"

Diagram for limiting static load worm drives, design A

Table 3



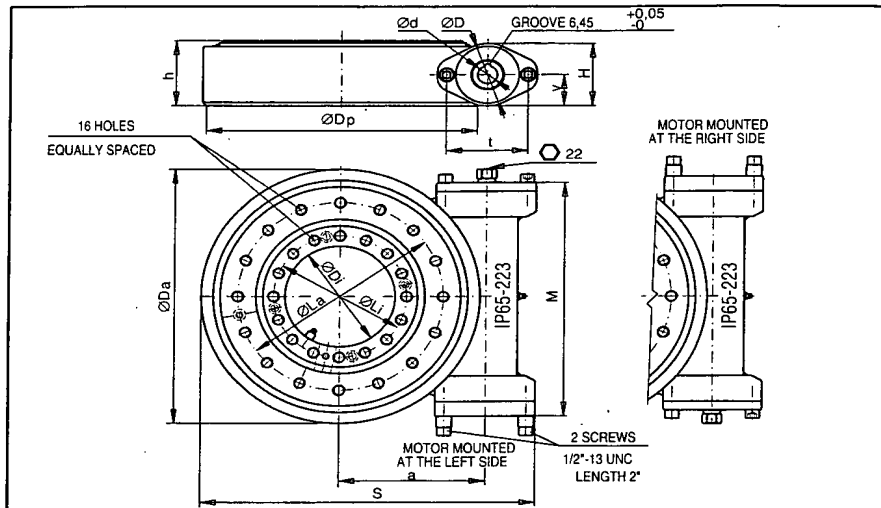
General parameters for worm drives, design A

Table 4

Specification	Unit	IP60-223	IP85-343	IP103-422
Weight	[kg]	37	51	86
	[lb]	82	112	190
Input torque	[Nm]	58	54	108
	[lb.ft]	43	40	80
Output torque	[Nm]	2800	3640	8900
	[lb.ft]	2065	2685	6564
Max. output rotation	[rpm]	13	10	8

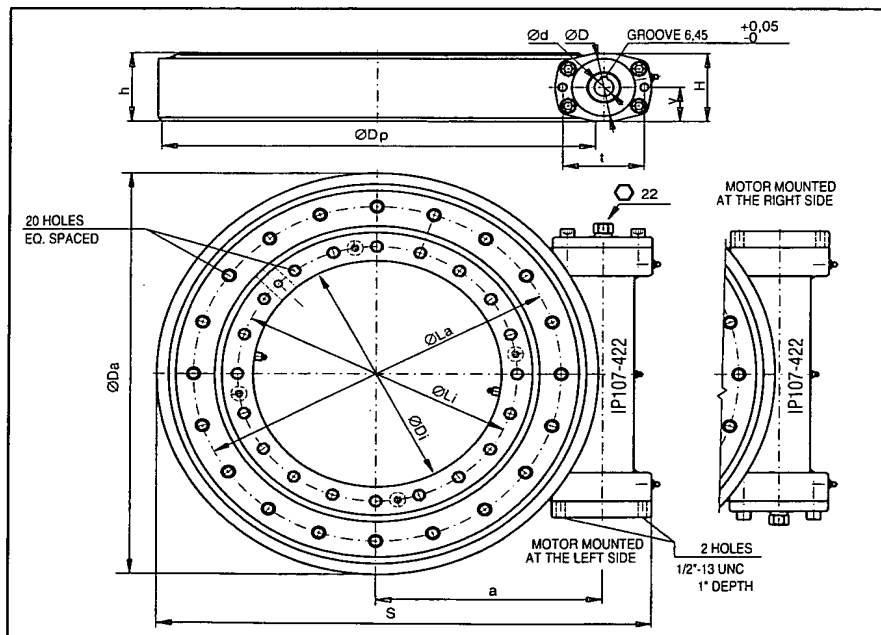
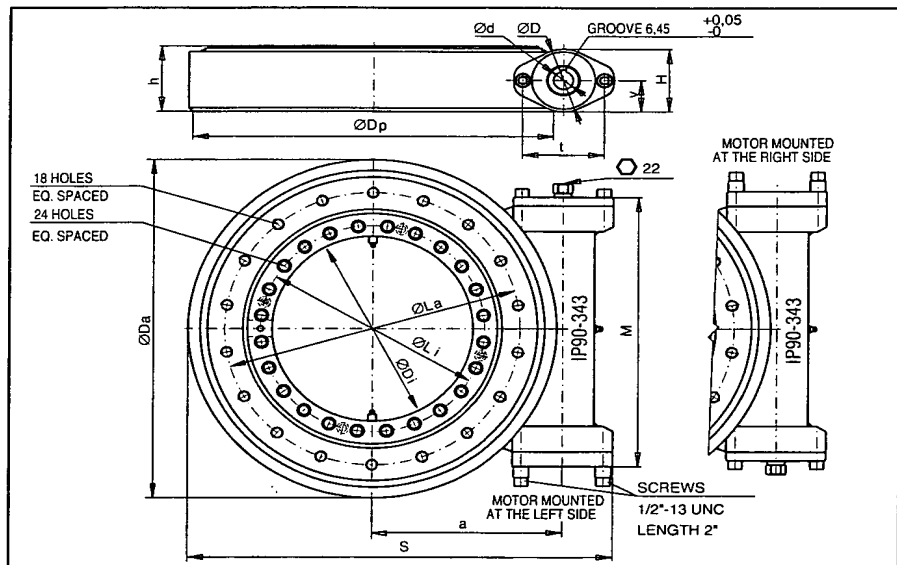


COVERED WORM DRIVES



Small worm drive
IP65-223L/R
Design D, H, M

Medium worm drive
IP90-343L/R
Design D, H, M



Heavy duty worm drive
IP107-422L/R
Design D, H, M



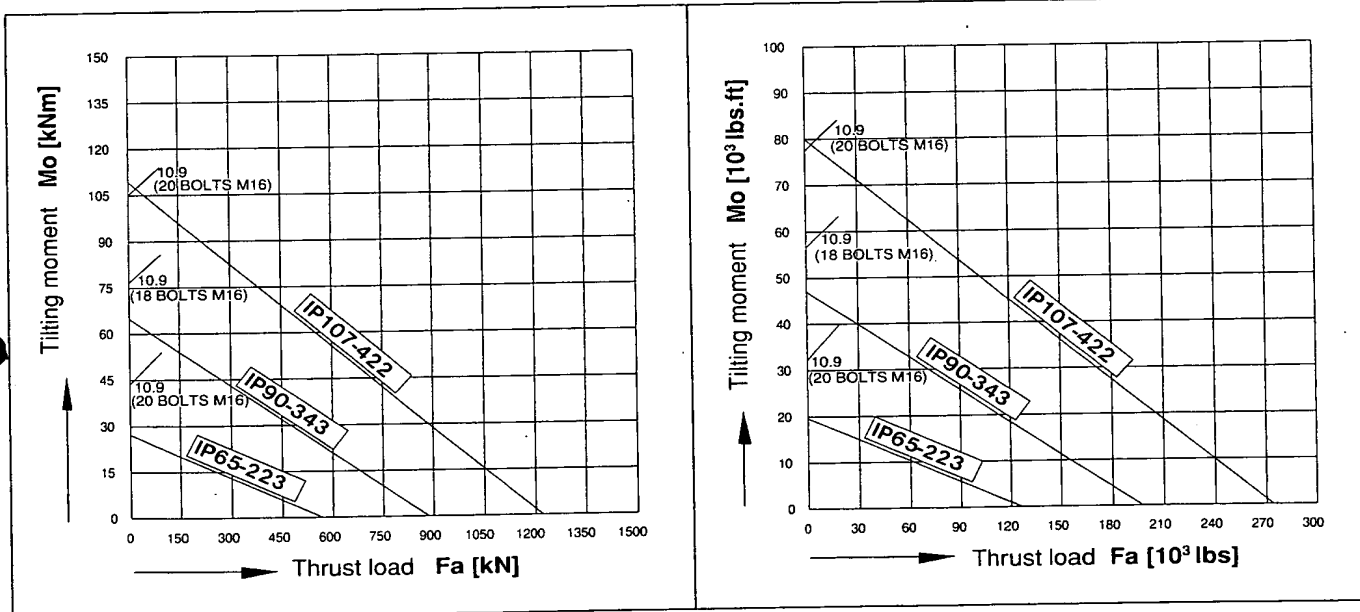
Boundary dimensions for worm drives, design D, H, M

Table 5

Designation	IP65-223		IP90-343		IP107-422	
	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
ϕd	25,5	1.004"	25,5	1.004"	25,5	1.004"
ϕD	82,6	3.25"	82,6	3.25"	82,6	3.25"
ϕLi	175	6.89"	295	11.614"	365	14.37"
ϕLa	270	10.63"	390	15.354"	479,4	18.874"
ϕDi	145	5.708"	265	10.433"	300	11.811"
ϕDa	365	14.370"	485	19.094"	527,8	20.78"
ϕDp	355	13.796"	475	18.700"	425	16.7"
h	94	3.70"	94	3.70"	91	3.58"
H	90	3.54"	90	3.54"	111	4.37"
v	45	1.772"	45	1.772"	63,5	2.5"
t	106,4	4.189"	106,4	4.189"	106,4	4.189"
a	190	7.480"	250	9.842"	282,8	11.13"
S	438	17.05"	558	21.97"	617,5	24.3"
M	336	13.3"	386	15.2"	389	15.31"

Diagram for limiting static load worm drives, design D, H, M

Table 6



General parameters for worm drives, design D, H, M

Table 7

Specification	Unit	IP65-223	IP90-343	IP107-422
Weight	[kg]	51	74	110
	[lb]	112	163	243
Input torque	[Nm]	92	83	175
	[lb.ft]	68	61	129
Output torque	[Nm]	2980	3740	9350
	[lb.ft]	2198	2758	6896
Max. output rotation	[rpm]	13	10	8



WORM DRIVE SELECTION

In order to decide on which worm drive size is applicable, the following data is needed:

- size, direction and time utilization of the operating load
- required life
- operating rotational speed, or number of work cycles/working angle
(1 work cycle = 2 working angles)
- work environment requirements
- mounting and maintenance requirements

The priority criterion is a reliable load transmission, i. e. adequacy of the raceways, gear and fixing bolts.

Calculation of equivalent axial and moment static load

Table 8

Formula	Conditions of validity	
$F'_{OA} = (F_{OA} + 5,05 \cdot F_{OR}) \cdot s_o$ $M'_{OK} = M_{OK} \cdot s_o$	$0,1 < \frac{F_{OR}}{F_{OA}} < 8$	$e > 2$
$F'_{OA} = (1,23 \cdot F_{OA} + 2,68 \cdot F_{OR}) \cdot s_o$ $M'_{OK} = 1,23 \cdot M_{OK} \cdot s_o$	$0,1 < \frac{F_{OR}}{F_{OA}} < 8$	$e \leq 2$

F_{OA}	– Σ axial static forces on the slewing ring	[kN]
F_{OR}	– Σ radial static forces on the slewing ring	[kN]
M_{OK}	– Σ tilting static moments on the slewing ring	[kNm]
s_o	– static safety factor	[–]
	$s_o = 1$ for normal operating conditions	
	$s_o = 1.1$ to 1.5 – according to operating conditions	
e	$= \frac{2000 \cdot M_{OK}}{F_{OA} \cdot D_s}$ – load eccentricity parameter	[–]
D_s	– mean diameter of slewing ring	[mm]

Note: – if $\frac{F_{OR}}{F_{OA}} < 0,1$ – it is not necessary to take into account the radial force when calculating the equivalent load

How to proceed when selecting a suitable worm drive:

The calculated values of the equivalent axial and moment static loads are defined in their respective coordinates system marked by the operating point in the diagram of a limiting static load (tables 3 and 6). The calculated operating point must lie under the curve for the limiting static loads of raceways and bolts.

FASTENING BOLTS

For fastening of the worm drives, bolts class 10.9 (according to ISO) or grade 8 (according to SAE) must be used.

The fastening bolt length has to be $l = 5 \times d$.

Bolt tightening torque:

Threaded bolt M16	279 Nm (206 lb.ft)
Threaded bolt 5/8" - 11 UNC	260 Nm (192 lb.ft)



MOUNTING AND MAINTENANCE OF WORM DRIVES

Mounting is based upon gradual tightening of the bolts, while alternating opposite one another. First, gently tighten all bolts with half the prescribed moment, then second proceed with full prescribed tightening moment.

When completed final inspection of the prescribed tightening moment should be performed.

After mounting, it is necessary to:

- check the lubrication of all worm drive functional parts (especially of the gear).
- measure the initial tilting clearance under minimum and maximum loads.
- record measured data in the machine operation diary.

The maintenance is based upon the regular relubrication of the slewing ring raceways, gear and worm bearings. Inspection of wear should be completed as well.

Open/Uncovered Worm Drives:

In a presumed constant cyclical operation (application such as an assembling platform) it is sufficient for functional parts to be lubricated once per year.

The recommended lubricants are:

- lithium lubricants of the consistency 2 with EP additives for the raceways of the slewing ring and worm bearings.
- grease for open drives for the gear.

The relubrication of the slewing ring raceway, worm bearing and gear must be performed so that all functional surfaces are lubricated to approximately 70 per cent (the filling factor 70 %).

When more frequent use of the equipment is applicable (more than 8 hours/day) or at a small swing angle it is suitable to relubricate more often, i. e. approximately once every 4 months.

Covered Worm Drives:

- they are filled with lithium grease that has a long life period "Tribol 4020/220-2 TGOA" or its equivalent.
- they require the relubrication of the slewing ring raceway and gear. The relubrication interval depends on operation frequency. The worm bearings relubrication is not needed, for the initial lubrication lasts the entire period of the presumed life (6 000 operating hours).

The Inspection of Wear

The indicator of the wear of the slewing ring raceway is an increase in the tilting clearance.

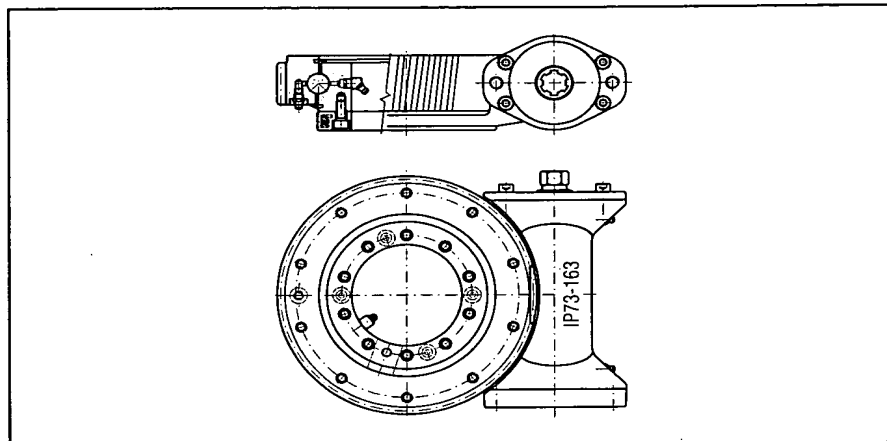
The permissible increase in the tilting clearance may be max. app. 1.5 mm. The signal of the gear wear is an increased backlash. The permissible magnitude of the backlash depends on the swing drive type applied.

Note:

In the event of an excessive wear or an increase in the slewing ring tilting clearance or backlash of the gear engaged, it is necessary to consult the PSL, a. s., Technical Department for permissible values.

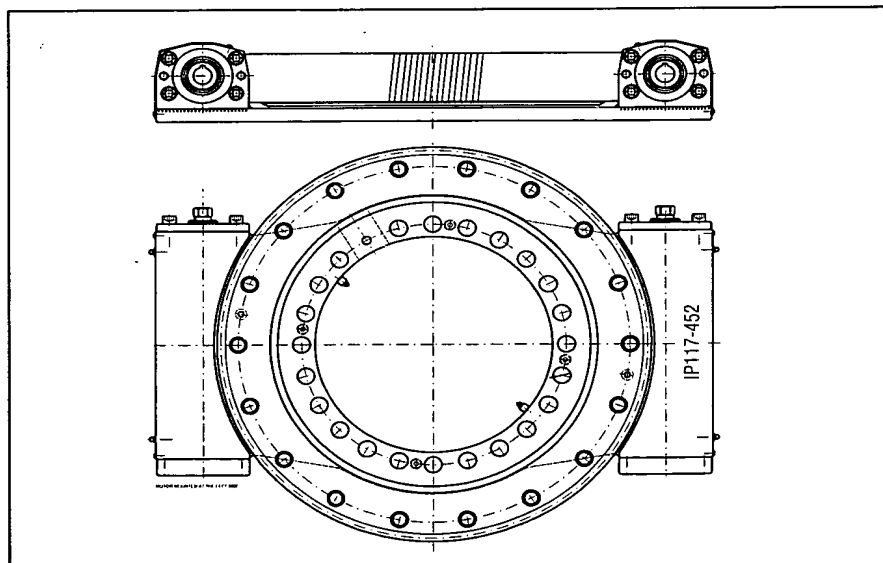
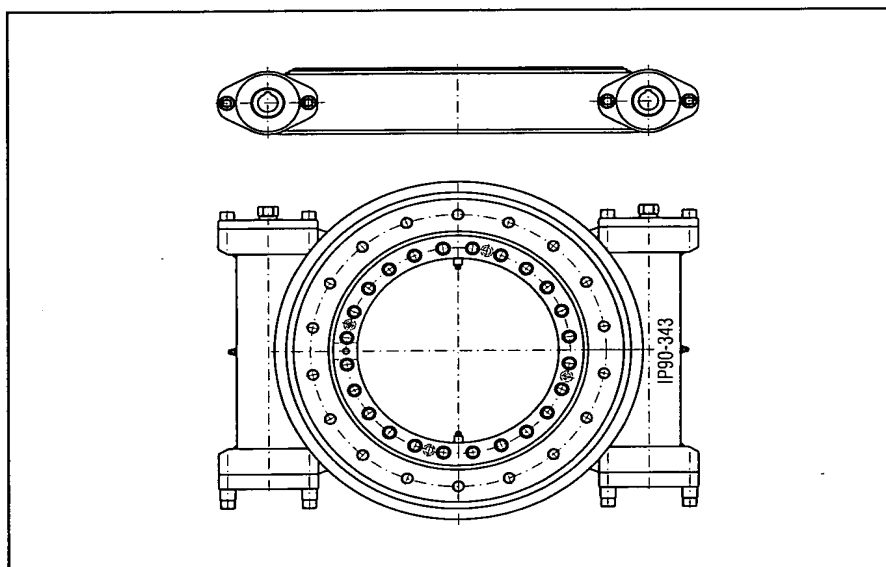


OTHER PSL WORM DRIVE DESIGNS



Mini worm drive
IP73-163L/R
Design A

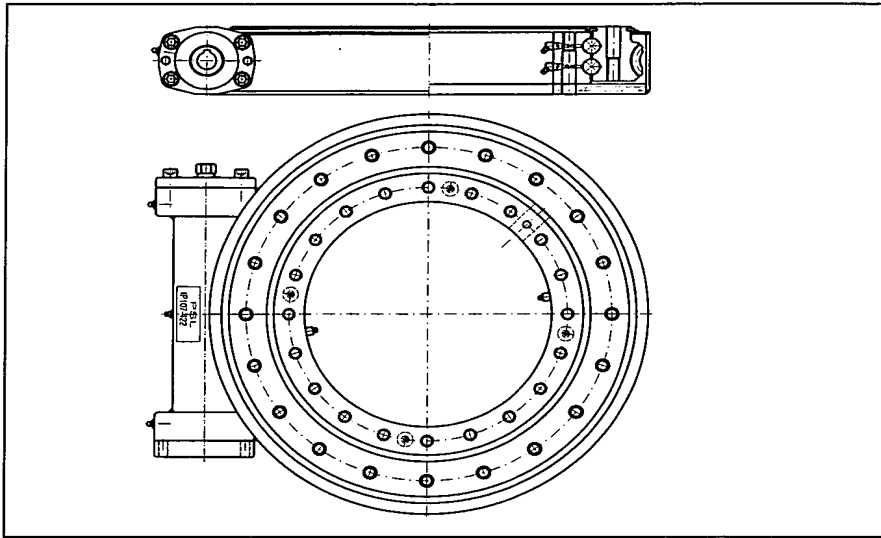
**Medium worm drive
with 2 worms**
IP90-343D
Design D



**Heavy duty worm drive
with 2 worms**
IP117-452D
Design B

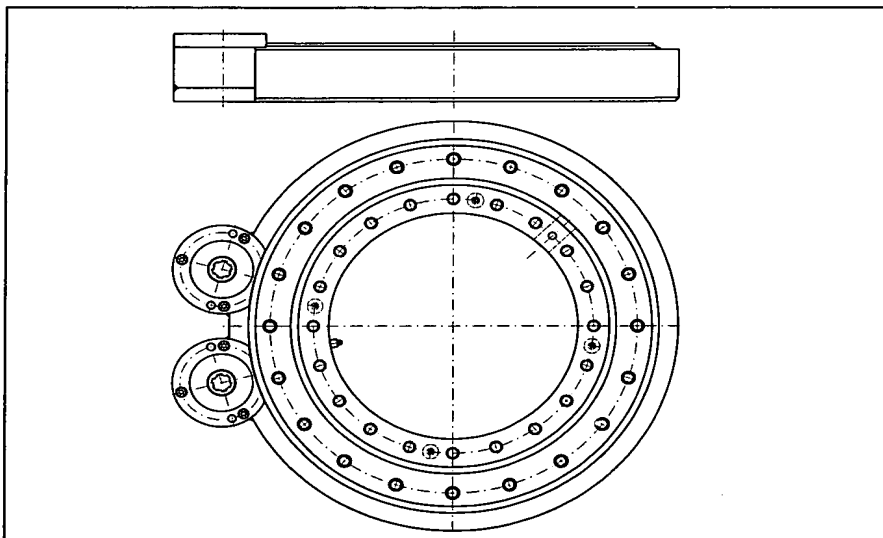
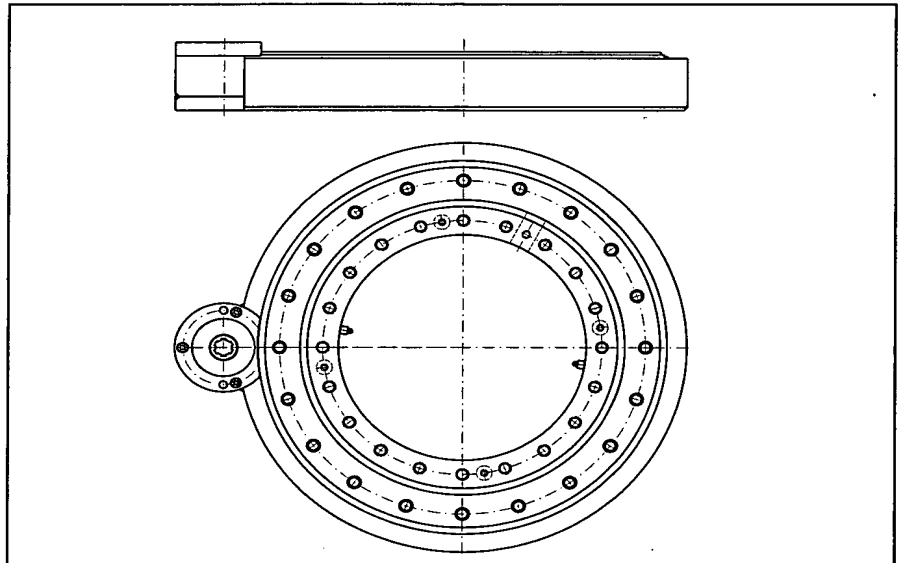


OTHER PSL WORM DRIVE DESIGNS



**Heavy duty worm drive
with double row
slewing ring**
IP107-422L/R
Design H

**Heavy duty drive
with pinion**
IP8,6-422
Design R



**Heavy duty drive
with 2 pinions**
IP8,6-422D
Design R

WORM DRIVE – DESIGN WORKSHEET

Company:
Address:

Name:
Department
Tel:
Fax:
E-mail:

Application/Type of machine:

Axis of rotation*:

- vertical ☐
- horizontal ☐
- angular ☐ °
- variable ☐

Rotation mode*:

- continuous rotation ☐
- intermittent rotation ☐
- cyclic or positioning only ☐

Load characteristics*

Bearing under

compression ☐
tension ☐

shocks ☐

vibrations ☐

Load		working load		test	extreme
		average	maximum		
axial	[kN]				
	lb				
radial	[kN]				
	lb				
tilting moment	[kNm]				
	[10 ³ .lb.ft]				
torque	[kNm]				
	[10 ³ .lb.ft]				

Drive ratio*

60 ☐
65 ☐

85 ☐
90 ☐

103 ☐
107 ☐

other

Rotational speed

average min⁻¹

maximum min⁻¹

cyclic operation: number of cycles/hour
working angle

..... cycles/hour
±

Operating conditions

number of operating hours

hours/day

thereof rotational (oscillatory) time

%

number of operating hours

hours/year

required life

..... hours

Operating temperature

outer ring °C

inner ring

..... °C

Driving motor

type

torque

coupling of driving motor* at the left side ☐

at the right side ☐

Remarks: (environmental conditions, dustiness, humidity, aggressive properties, etc.)

Necessary data

Required date of offer

Quoted quantity

pcs

Required date of delivery

Annual requirements

pcs/year

Please fully complete this form. Incomplete information will delay our proposal.

Individual consultation required. Please call for appointment.* ☐

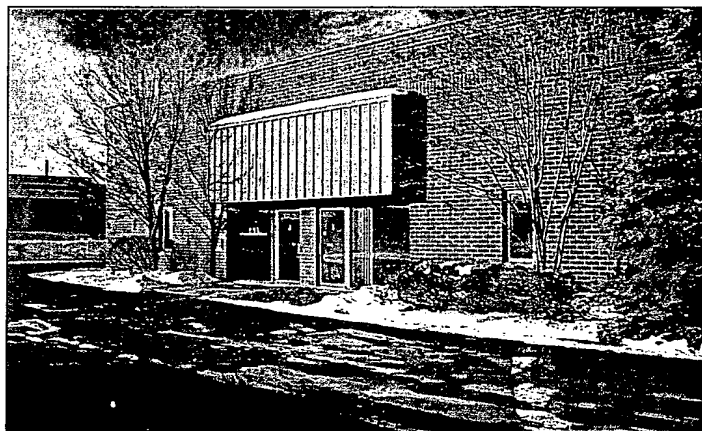
*Please check appropriate

Date: Signature:



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